Answers to the AFNI Test

1) *Explain the difference between* **`Min-to-Max`** *and* **`2%-to-98%`** *in the AFNI image viewer. Why is* **`2%-to-98%`** *the default?*

The numbers in an non-RGB image (e.g., an image of bytes, shorts, or floats) must be scaled to give colors or gray levels to display on the screen. When displaying a 2D slice, the image viewer determines bottom and top clip levels from the image, and then linearly scales all the values so that image values below the bottom clip level get the color at the bottom of the intensity bar, image values above the top clip level get the color at the top of the intensity bar, and values in between the two clip levels get the intermediate colors. The **`Min-to-Max`** and **`2%-to-98%`** differ in how these clip levels are determined. **`Min-to-Max`** takes the bottom clip level to be the minimum value in the 2D image, and the top clip level to be the maximum value in the 2D image. If there are only a few very large pixels in the image, then **`Min-to-Max`** will cause the rest of the image to appear "washed out". This is why the default is **`2%-to-98%`**, where the cumulative histogram of the numbers in the 2D image is calculated, then the bottom clip levels is taken at the 2% level in the histogram and the top clip level at the 98% level in the histogram. If only a few extreme voxels occur (e.g., arterial inflow artifacts in T_1-weighted images), then these will not control the scaling of the entire images. It is very common to use T_1-weighted datasets as the background for AFNI displays, and such images usually have a few artifactually bright spots; thus, **`2%-to-98%`** is the default. If you want **`Min-to-Max`** to be the default, set environment variable **`AFNI_IMAGE_MINTOMAX`** to **`YES`**.

2) *What does the* **`R`** *key do when typed into an AFNI image viewer window? What about in a graph viewer window? What about the lower case '*__`r`__*'?*

The **R** key starts displaying all the images in the viewer's buffer sequentially in time, moving first backward in index from the current image down to image #0, then forward again through images #1, #2 … until the last image, then backwards, then forwards … until the user presses some other key in the image window or closes the viewer. The **`r`** key is the same, but the sequence of display starts at the current image and goes forward first, then backwards. (**`R`** is for "ricochet", as **`V`** is for "video".)

3) *On some computer systems, it is possible to drag an image viewer window so that its aspect ratio (height/width) is not preserved; in this situation, the image becomes distorted. Describe at least 2 ways to bring the image viewer quickly back into the correct aspect ratio.*

X11 display systems are supposed to enforce window aspect ratio if so ordered; AFNI orders this to be enforced for image viewer windows. However, some X11 systems do not obey the standard. If the image becomes distorted, two quick ways to undistort it are to press the **`a`** key while the mouse is over the image itself, or to Left-click in the vertical intensity bar just to the right of the image.

4) *What does the* **`Project`** *menu button do in the AFNI image viewer* **`Disp`** *control panel?*

This option allows the displayed image to be computed from several adjacent slices, pixel-by-pixel. For example, set **`Project`** to **`Minimum`** and **`Slab+-`** to **`2`**, and then the numerical value for each pixel will be the minimum over 5 slices: the current slice, and the 2 nearest neighbors on either side. This functionality was implemented to display venograms (high resolution T_2^*-weighted GRE images), but I'm sure can be fun for other purposes.

5) *When you have 2 (or more) AFNI controllers open, how can you lock their threshold sliders so that they move together?*

On the **Edit Environment** control panel (available from a lot of places, including the Right-click popup on the **Inten** label above the color bar next to the threshold slider), set the variable **AFNI_THRESH_LOCK** to **YES** or **P-VALUE**, depending on if you want to lock the actual threshold values together, or their nominal *p*-values. Then press the **Set+Close** button to actually set the variable. The next time you change any threshold slider, the others will follow.

6) *In an AFNI graph viewer window, how can you get a display of the time series that is the average of all the sub-graphs currently being shown?*

This is easy: in the graph window, the **FIM→Edit Ideal→Ideal=WinAver** button will set the red 'Ideal' plot to be the average of the sub-graph time series being displayed in the current matrix.

7) *Suppose you are showing a time series graph of a very long 3D+time dataset, and want to only see the points between time indexes 200..400 displayed in the graphs. How can you do this?*

In the graph window, the **Opt→Grid→Index Pin** menu item will popup a small window that lets you choose the bottom and top indexes to display.

8) *Explain the 3 different baseline modes available in an AFNI graph viewer.*

9) *Given a list of (x,y,z) coordinates, describe how to create an AFNI dataset that equals 1 at each voxel inside a radius=5 mm sphere about each coordinate in the list, and is 0 at all other voxels.*

The **3dUndump** program is the tool for this job. If the (*x*,*y*,*z*) coordinates are stored in file **zork.1D**, then the command

```
3dUndump -xyz -srad 5.0 -master mmm.nii -prefix sss.nii zork.1D
```

will carry out this task, where **mmm.nii** is a dataset whose dimensions will be used to set the size, orientation, etc., of the output dataset **sss.nii**.

10) *Why it is better to use the **3dcopy** program to make a copy of an AFNI dataset (.HEAD and .BRIK files) rather than use the Unix **cp** command twice?*

Every AFNI dataset (including those stored in the NIfTI-1 format) has a unique identifier (ID) code stored in its header. These codes are used in various ways to link datasets together. If you use the Unix **cp** command, then the new dataset will have the same ID code as the original, and in a few instances AFNI may become confused about which one to use. If you use **3dcopy**, then the new dataset will get a different ID code, and such confusion can be avoided.

11) *How do you get AFNI **3d** programs to treat a .1D file with a single column of numbers as a 1-voxel 3D+time dataset? As a multi-voxel dataset with 1 value at each voxel?*

12) *How do you get AFNI to automatically compress output **.BRIK** files with **gzip**?*

Set environment variable **AFNI_COMPRESSOR** to **GZIP**. If the gzip program is in your path, then AFNI will always write through a pipe to '**gzip -1**', so that all output **.BRIK** files will actually end up as **.BRIK.gz** files. **N.B.**: You do not have to set any environment variable for AFNI to be able to read **.BRIK.gz** or **.nii.gz** files – it will do so automatically.

13) *What does the command below do?*

```
afni -dset "v1+orig<`3dClipLevel 'v1+orig[4]'`..10000>"
```

Explain the use of the 3 different kinds of quotes. *(What kind of person thought of this, anyway?)*

14) *Suppose you have two 1-brick datasets* **aaa+orig** *and* **bbb+orig**, *and want to extract from a 3D+time dataset* **xxx+orig** *the average time series over all voxels where both* **aaa+orig** *and* **bbb+orig** *are bigger than 3 (i.e., perform a conjunction test). Explain how to do this in a single command.*

15) *The* **Rota** *arrow buttons on the* **Define Overlay** *control panel rotate the color bar. How can you save a movie (animated GIF or MPEG-1) of the changes that happen in an AFNI image viewer as the color overlay changes while you interactively press a* **Rota** *button?*

16) *In an AFNI image viewer, you can both crop and zoom an image. What happens when you* **Save** *such an image to disk (e.g., in a JPEG file)? Is it cropped, zoomed, both, or neither?*

17) *In an AFNI graph viewer, you can filter the time series in each voxel using the* **Tran 1D** *transformation functions. One of these pre-programmed filters is a "Median-of-3" filter. How can you do a "Median-of-7" filter instead? (Interactively: i.e., without writing new C code.)*

18) *How can you make the color overlay be computed from the square root of an F-statistic sub-brick, rather than the F-statistic value itself? (Interactively; i.e., without using* **3dcalc**.*)*

19) *Describe how to input a short .1D file directly on the command line, rather than via an actual file stored on disk.*

When an AFNI program expects a .1D filename, if the filename starts with the characters "**1D:**", then the data values will be taken directly from the "filename" immediately following the colon character. For example, try this command: **1dplot '1D:3 4 3 4 5 \ 1 2 3 4 3 2 1'** – note how the first 'column' of data '**3 4 3 4 5**' is separated from the second by the '****' character set off by spaces, and also note that the entire string is in single quotes. One useful place for this input method is the **-concat** option to program **3dDeconvolve**.